

IN-SITU MICROWAVE BRIGHTNESS TEMPERATURE VARIABILITY FROM GROUND-BASED RADIOMETER MEASUREMENTS AT DOME C IN ANTARCTICA INDUCED BY WIND-FORMED FEATURES

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1. INTRODUCTION

Space-borne microwave radiometers are among the most useful tools to study snow and to collect information on the Antarctic climate. They have several advantages over other remote sensing techniques: high sensitivity to snow properties of interest (temperature, grain size, density), subdaily coverage in the polar regions, and their observations are independent of cloud conditions and solar illumination. Thus, microwave radiometers are widely used to retrieve information over snow-covered regions. For the Antarctic Plateau, many studies presenting retrieval algorithms or numerical simulations have assumed, explicitly or not, that the subpixel-scale heterogeneity is negligible and that the retrieved properties were representative of whole pixels. In this presentation, we investigate the spatial variations of brightness temperature over a range of a few kilometers in the Dome C area (Antarctic Plateau).

2. METHODOLOGY

Using ground-based radiometers towed by a vehicle allowing measurements with meter resolution, we collected brightness temperature transects at 11, 19 and 37 GHz at horizontal and vertical polarizations. The most remarkable observation was a series of regular undulations of the signal with a significant amplitude of up to 10 K at 37 GHz and a quasi-period of 30–50 m (Figure 1, top panel). In contrast, the variability at longer length scales seemed to be weak in the investigated area and the mean brightness temperature was close to AMSR-E and WindSat satellite observations for all the frequencies and polarizations. To establish a link between the snow characteristics and undulation-scale variations of microwave emission, we collected detailed snow grain size and density profiles to run the DMRT-ML microwave emission model at two points where opposite extrema of brightness temperature were observed. These snow property measurements were completed during the austral summer 2013 and 2014 field campaigns.

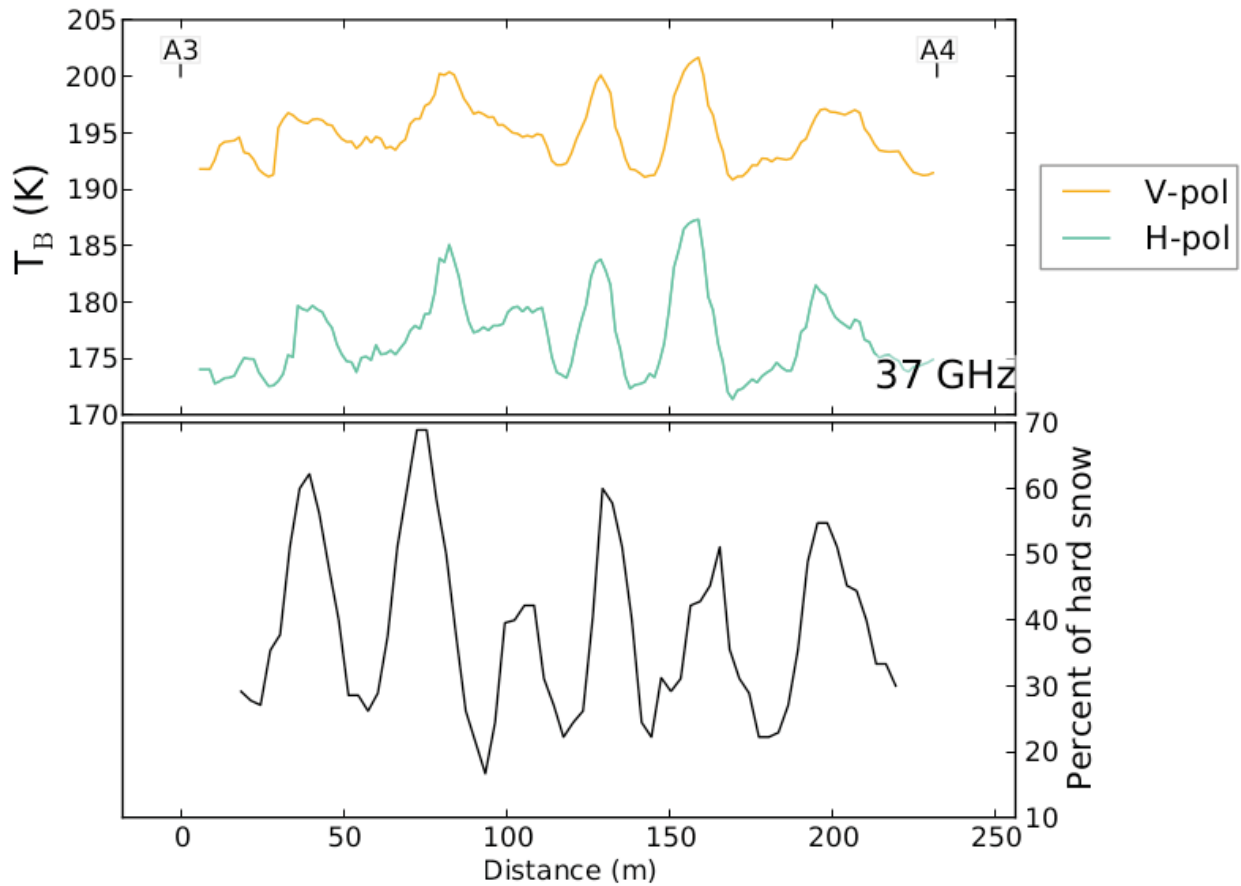


Figure 1. Top: Brightness temperature variation at 37 GHz along one transect. Bottom: Percentage of hard snow within the top 30 cm of the snowpack.

3. RESULTS

The numerical simulations revealed that the difference in density of the upper first meter of the snowpack explained most of the brightness temperature variations. In addition, we found in the field that these variations of density clearly visible were linked to the hardness of the snowpack. Although actual passive microwave sensor cannot spatially resolve these features, the satellite signal could be sensitive to the proportions of these forms which can cover as much as 40 to 50 % of the investigated area and are variable in time. During the 2013/14 summer campaign, the dunes were clearly visible at the surface as in 2006. This allowed to further analyze their occurrence and their general characteristics. The formation processes and their persistence remain unknown. The sensitivity of the brightness temperature to these surface dunes (TB higher than in normal areas) implied that the microwave emission measured by satellites over Dome C is more complex than expected and very likely depends on the areal proportion of the two different types of areas having distinct snow properties. This analysis is discussed in the perspective of historical Tb variations along the last 10 years of AMSR data over the Dome C site.

4. REFERENCES

Picard, G., Royer, A., Arnaud, L., and Fily, M.: Influence of meter-scale wind-formed features on the variability of the microwave brightness temperature around Dome C in Antarctica, *The Cryosphere Discuss.*, 7, 3675-3716, doi:10.5194/tcd-7-3675-2013, 2013.